F L E X

Facility for Low Energy eXperiments in Buildings

FLEX for Demand Response – Use Case

Linking Energy-Efficient Operations with Automated Demand Response

The Challenge

The vast majority of new, low-energy building systems have clear concepts for energy efficiency. For example, dimming lighting, radiant cooling, demand-controlled ventilation all have clear objectives for low-energy operations. Less well known are the requirements for designing, operating and automating low-energy systems for demand responsiveness.

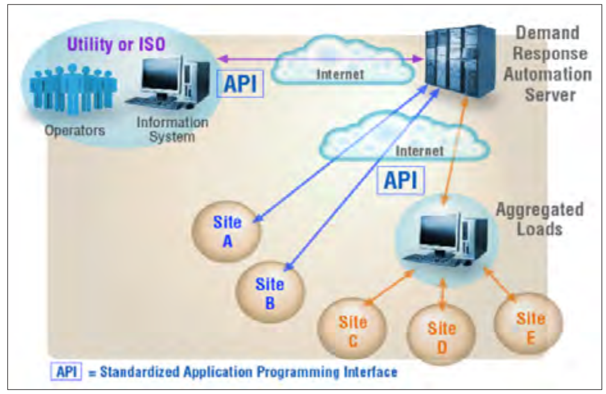
Consider **Demand Response (DR) control strategies** and how **FLEX** provides a path to solutions that will help accelerate innovation. **FLEX** offers high-quality continuous measurements combined with calibrated models of the facility to develop control strategies to evaluate how various sequences of operations perform at both the component and system level.

Starting Point

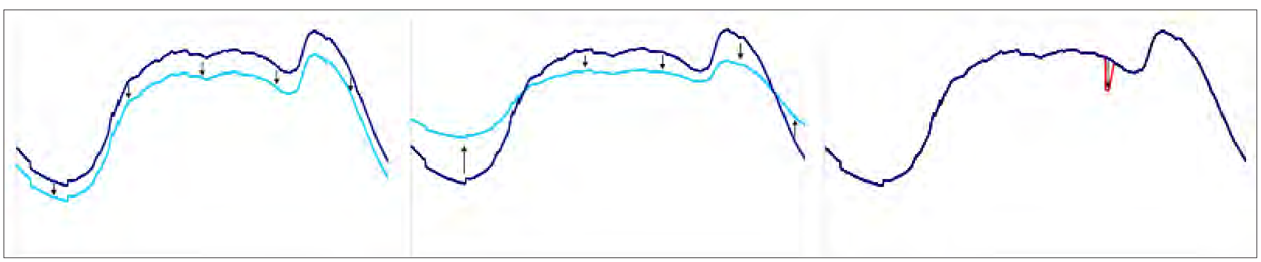
A control company or designer of a new "system" targeted for retrofit applications, that includes Automated Demand Response, lighting control, and advanced HVAC concepts. The system has been designed based on the capabilities of the components, but has not been tested as an integrated system.

Solution Pathway

The control company conducts a six-month field-performance test, leveraging testbed measurement and monitoring capabilities for energy performance and control strategy analysis to evaluate how the integrated system should operate in different modes – full service and full occupancy, reduced service, night time standby, and low-power.



An Open Automated Demand Response (OpenADR) communications test facility, part of FLEX, incorporates a client-server automation architecture using an open application-programming interface.



Load shape modifications – energy efficiency, peak demand reduction, reliability response.

Testbed Capabilities	Performance Parameters and Benefits
Lighting system and fixture power and energy and demand	System energy use, and peak demand; energy savings relative to non-controlled 1980s retrofit base-case in twin cell
HVAC control and energy use	Zonal load measurement, hydronic or air
Robust data acquisition system to accommodate additional instrumentation	Flexibility to integrate experiment-specific measurement hardware with existing testbed instrumentation
DR automation server and client designs	Client-server capabilities, price and reliability signals, latency testing
Energy and demand response models	EnergyPlus and Modelica tools to model control strategies, HVAC, lighting, and whole "testbed" energy use

Immediate Outcomes

- Validation or optimization of sequences of operations.
- Demand Response capabilities analysis.
- Immediate results and information to adjust system control logic, or component performance, if energy or comfort performance is lower than target.
- Extrapolate results for diverse climates and related designs.
- Use holistic archival set of high-quality field-measured data for documentation and publication.

Extended Validation & Deployment Opportunities

- Explore a large variety of economic targets based on electricity tariff designs.
- Evaluate latency of control communications.
- Test interoperability with multiple control and automation and metering systems.
- **Partner with LBNL researchers** with subject matter expertise.
- Use field-measured data to inform critical performance drivers, and how to cost-effectively measure them, for as-installed operational diagnostics, continuous commissioning, and automated energy performance reporting.
- Build partnerships with **early-adopter FLEX members** to conduct scaled demonstrations in real-world buildings across the country.
- Use testbed and early adopter data, in combination with access to **utility/state testbed members**, to share benefits for emerging technology and new incentive programs, and to inform future code requirements.
- Provide generalized system design and operational performance data to **members of the engineering community** using the virtual design capabilities.

References and Further Reading

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